

Translation of:

AIRCRAFT ACCIDENT INVESTIGATION REPORT

Crash Accident of Mi-8, P-313, Air Koryo
On 9 July, 2005
In Chonnamri, Hyongjesan District, Pyongyang

**Aircraft Accident Investigation Committee,
General Administration of Civil Aviation,
Democratic People's Republic of Korea**

(This translation of the official Korean report is to serve for information only.)

The sole objective of the investigation to aircraft accident or incident is to determine the circumstances and causes and take measures, with a view to avoiding similar occurrences in the future. It is not the objective of the investigation to assign fault or blame or determine liability.

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GENERAL

Aircraft Accident Investigation Committee, which was organized by the General Administration of Civil Aviation in accordance with the Law of DPRK on Civil Aviation, Chapter 8, 79 and 80 has investigated the accident of Mi-8, P-313, Air Koryo.

The Committee has investigated the accident from 10 July to 3 October, 2005 in accordance with the "Regulation of Aircraft Accident and Incident Investigation" (second edition, 2004).

Air Koryo has been making use of helicopters for transportation of passengers and cargo in domestic areas since 1 October, 2000.

At the request of the Ministry of Public Health, Air Koryo organized an emergency flight to Jamaedo, Nampo City, South Pyongan Province to carry a pregnant woman with triplet at 20:40 on 9 July, 2005.

This flight was assigned to Ri Jang Gil, pilot-in-command, Pak Won Chol, co-pilot, and Min Tong Gil, flight engineer.

At around 23:11, on its way back to Pyongyang airport with the pregnant on board, the helicopter crashed in Chonnamri, Hyongjesan District, Pyongyang which is some 5 km north-west of Sopo Station (N39° 06', E125° 42'), and was totally destroyed and burnt out.

All persons on board including the crew suffered fatal injuries.

The Committee has concluded that this accident was attributed to the crew who had a misinterpretation of engine oil system meter readings to stop an engine, which was operating normally, and failed to conduct correct helicopter operation following that condition.

All times in this report are local times. It is 9 hours ahead of UTC.

1. FACTUAL INFORMATION

1.1 History of the flight

1.1.1 On 9 July, 2005, Air Koryo was requested by the Ministry of Public Health to carry a pregnant with triplets in Jamaedo, Nampo City, South Pyongan Province to Pyongyang Maternity Hospital.

1.1.2 Accepting this flight at 20:40, the crew made pre-flight preparations in accordance with established procedures.

The crew calculated navigation elements necessary for en-route flight and approach, on the basis of weather and forecasts of aerodrome, landing pad and route.

They also consulted and confirmed flight procedures, taking account of prohibited areas and obstacles around the route and landing pad.

With report from the chief engineer that the helicopter was prepared for flight, the pilot-in-command completed pre-flight preparation with the co-pilot in the cockpit.

1.1.3 As it was a flight at night, the fleet chief emphasized that the crew should identify the local landing pad correctly and conduct flight safely.

1.1.4 Maintenance was performed for 5 hours in the morning that day by technical personnel of the 3rd Technical Service in accordance with maintenance schedule and procedures.

Maintenance work was done by specialized technical personnel in accordance with A2 type maintenance process and procedures.

After this helicopter preparation for duty, the chief of the Technical Service inspected the helicopter in accordance with the established checklists and procedures.

1.1.5 As the weather conditions of route and landing areas were within the operating minima, the crew took off at 21:20 at Pyongyang aerodrome with the approval of ATC.

Crew ascended to 900m along the route of Sunan-Kanri-Ryupori-Jamaedo and flew at 200km/h of cruising speed.

After take-off, the pilot-in-command reported all mechanical systems including engines were in good condition and the flight conditions were relatively not so bad.

1.1.6 The crew, after landing in Jamaedo at 21:57, conducted intermediate helicopter checks and inspections.

1.1.7 The crew departed for Pyongyang aerodrome at 22:46 with the pregnant on board and flew at the altitude of 900m.

The pilot-in-command reported at 22:50 that all systems were operating normal, flight conditions being good and a little cloud being over at the altitude of 900m.

He reported transit over Ryupori at 23:02 and requested approval of descent from 900m down to 300m for the purpose of approach and landing.

While approving it, the controller informed him of meteorological information; wind 150° 3m/s, visibility 7,000m, cloud 7 bars, ceiling 800m, temperature 21 degrees, QFE 749mm, runway in use 35.

1.1.8 Upon receipt of the crew report, the controller instructed to conduct enroute flight precisely so as not to deviate to the prohibited areas.

1.1.9 At around 23:10, the pilot-in-command reported urgently that the left engine oil pressure was falling down. Soon after that, he said “engine shut off”.

1.1.10 The controller requested to recheck the engine oil system meter readings, but received no answers.

1.1.11 The controller lost the helicopter on radar, shortly after the urgent report by the pilot-in-command.

1.1.12 He continued to call the crew in contact with military control, but could not track the location of the helicopter.

1.1.13 Being in contact with the military control, at around 23:15, he reported to GACA and Air Koryo that P-313 was missing.

1.1.14 Shortly after that, upon notification by Pyongyang People’s Security Agency that an aircraft had crashed in Chonnamri, Hyongjesan District, ATC control ordered the aerodrome rescue unit to depart immediately.

1.1.15 At around 23:18, ATC reported to GACA and Air Koryo that the helicopter had crashed in Chonnamri, Hyongjesan District, which is some 10km south of aerodrome.

1.1.16 Upon the receipt of information by ATC, officials including the Deputy Director General and Director of Accident Investigation of GACA, Vice-President of Air Koryo departed for the accident place.

1.1.17 When they arrived there, fire fighters had been doing rescue and firefighting

1.2 Injuries to persons

All persons on board; a pregnant woman with triplets, an obstetrician, a nurse, and 3 crew members suffered fatal injuries. Besides, one guard at the site suffered 1 degree burn.

There was no other injury or hurt following the crash and the scattered pieces.

1.3 Damage to helicopter

The helicopter was totally destroyed and burnt out due to impact and following fire.

1.4 Other damage

As the fire caused by crashed helicopter expanded rapidly over warehouse building of the Central Relief Goods Control Centre, goods in stock suffered enormous damage.

1.5 Crew information

1.5.1 Ri Jang Gil, pilot-in-command (Male, 50 years old)

1.5.1.1 He graduated air force training centre on 29 July, 1978 and served as a co-pilot of a military Mi-8.

After completion of air force university course from 1 September 1987 to 31 July 1990, he became a fleet flight officer.

On 11 July, 2000, he was transferred to Air Koryo and worked as a flight officer of 3rd fleet, while he passed a CPL examination after completing recurrent training on civil aviation law and flight procedures.

1.5.1.2 He passed ATPL examination on 3 October, 2003.

1.5.1.3 The below table shows his experience and flight time;

Aircraft type	Flight time	Remarks
Yak-18	30.20	
Mi-8	1,200.38	
Total flight time	1,230.58	
Flying time at night	151.57	

1.5.1.4 His recent experience and flight time are as below;

experience	Last 1 week	Last 30 days	Last 90 days
Mi-8	4.27	10.05	25.53

1.5.1.5 He passed written examination on 21 September, 2004 and proficiency check on 7 April, 2005 for renewal of ATPL licence.

Licence No was ATPL 33108 which was valid until 2 October, 2005.

1.5.1.6 He was conducting VFR and IFR flights to/from domestic aerodromes and landing pads for transportation of passengers/goods and rescue.

1.5.1.7 He passed first class medical examination on 7 March, 2005, which was valid until 6 September, 2005.

He was subject to first class medical examination every six months.

1.5.1.8 He took a rest for 20 hours after last flight.

1.5.2 Pak Won Chol, co-pilot (Male, 39 years old)

1.5.2.1 He graduated air force training centre on 21 July, 1986 and served as a co-pilot of a military aircraft.

He started with Mi-4 and became a co-pilot of Mi-8 since 16 March, 1989.

1.5.2.2 He was transferred to Air Koryo on 11 July, 2000 and passed CPL examination on Mi-8 on 3 October, 2000 after recurrent training course related with civil aviation law, regulations and operating procedures.

1.5.2.3 He passed written examination on 21 September, 2004 and proficiency check on 7 April, 2005 for renewal of CPL licence.

His licence No was CPL 33156, which was valid until 2 October, 2005.

1.5.2.4 With instrument rating, he was conducting VFR and IFR flights to/from domestic aerodromes and landing pads for transportation of passengers and goods

1.5.2.5 The below table shows his experience and flight time;

Aircraft type	Flight time	Remarks
Yak-18	39.25	
Mi-4	131.14	

Mi-8	1,392.12	
Total flight time	1,562.51	
Flying time at night	81.11	

1.5.2.6 His recent experience and flight time are as below;

Experience	Last 1 week	Last 30 days	Last 90 days
Mi-8	4.27	10.05	25.53

1.5.2.7 He passed first class medical examination on 7 September, 2004, which was valid until 6 September, 2005.

He was subject to first class medical examination every year.

1.5.2.8 He took a rest for 20 hours after last flight.

1.5.3 Min Tong Gil, flight engineer (Male, 43 years old)

1.5.3.1 He served as a Mi-8 flight engineer after graduation from the Air Force University on 26 April, 1984.

1.5.3.2 After being transferred as a flight engineer to Air Koryo on 11 July, 2000, he received recurrent training on civil aviation law, regulations and operating procedures and passed flight engineer examination on 3 October, 2000.

1.5.3.3 He passed a written examination on 21 September, 2004 and a flight check on 3 March, 2005 for renewal of his licence.

Licence No was FE 33205, which was valid until 2 October, 2005.

1.5.3.4 He passed a first class medical examination on 7 March, 2005.

1.5.3.5 It was valid until 6 September, 2005.

He was subject to this medical examination every 6 months.

1.5.3.6 After conducting a flight to Mt.Chilbo for transportation of passengers on the previous day, he was on duty on 9 July, 2005.

1.5.3.7 The below table shows his experience and flight time;

Aircraft type	Flight time	Remarks
Mi-8	1,494.34	
Total flight time	1,494.34	

Flying time at night	262.55	
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1.5.3.8 His recent flight experience and flight time are as follows;

experience	Last 1 week	Last 30 days	Last 90 days
Mi-8	4.27	4.27	24.00

1.5.3.9 He took a rest for 20 hours after last flight.

1.6 Aircraft information

1.6.1 The helicopter, P-313, was manufactured on 27 March, 1973 in Kazan, former USSR.

It was equipped with 2 TB2-117AГ, each of which has a thrust power of 1,500hp.

The standard and maximum certificated take-off weights are 11,100kg and 12,000kg.

The registration mark was P-313 and serial number 20313.

1.6.2 GACA issued its certificate of airworthiness in accordance with the Civil Aviation Law, chapter 3, 21 and 22, and the Regulation of Airworthiness, part 1, chapter 2, 8.

The certificate of airworthiness which had been renewed on 17 September, 2004 was valid until 16 September, 2005.

Its No was GACA-A-073AW.

1.6.3 In-advance maintenance of the helicopter was done by 3rd Technical Service and scheduled maintenance done by maintenance workshop in accordance with airworthiness instructions and maintenance schedule.

1.6.4 The last helicopter overhaul was completed by repair factory No321 from 15 June, 1999 to 27 April, 2000.

1.6.5 Overhaul information is as follows;

No of overhauls	Repair factory	Date of overhaul	Flt time before overhaul	Lifespan (hrs & yrs)	Flt time after overhaul
First	Repair factory No321	10 Nov, 1981	1,000.00	1,000/7	970.47
Second	Repair factory No321	20 Feb, 1989	1,970.47	1,000/8	581.04

Third	Repair factory No321	27 Apr, 2000	2,551.51	750/8	476.10
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1.6.6 P-313 was undergone life extension works for 2 times in February, 1997 and August, 1998, after which its life was extended 18 months each.

1.6.7 Upon completion of the helicopter overhaul, the repair factory No321 defined its life as 750hrs/8years.

1.6.8 Total flight time of this helicopter before accident was 3,029.09 hours (including 1.05 hours that day).

1.6.9 After last overhaul, it operated for 476.10 hours.

1.6.10 Engines were installed to P-313 on 2 June, 2003 after they had been overhauled in March and April, 2002 for the second time in Russia.

1.6.11 Overhaul details of left engine (No C93311199) are as follows;

No of overhaul	Repair factory	Date of overhaul	Lifespan (hrs/yrs)	Time after overhaul	Total operating time
First	Ural engine repair factory, Russia	2 Dec, 1986	1,500/8	-	-
Second		4 Apr, 2002	1,500/12	274.15	940.13

1.6.12 Overhaul information of right engine (No C97411062) is as follows;

No of overhaul	Repair factory	Date of overhaul	Lifespan (hrs/yrs)	Time after overhaul	Total operating time
First	Ural engine repair factory, Russia	21 Dec, 1990	1,500/10	1,500.30	-
Second		31 Mar, 2002	1,500/12	274.15	3,250.24

1.6.13 Main rotor blades manufactured in 1999 were installed on P-313 on 2 August 2001. Their lifespan was 2,000 hrs/7 years. Total operating time was 427.29 hrs.

1.6.14 Tail rotor hub was installed on 2 August 2001, which had been overhauled in Russia on 29 January 2001.

1.6.15 Its lifespan was 5,000 hrs, while total operating time was 933.09hrs. The lifespan between overhaul was 1,000hrs/7 years and the operating time since overhaul was 427.29hrs.

1.6.16 Tail rotor blades manufactured in 2001 were installed on this helicopter.

Lifespan of tail rotor was 1,500hrs/7 years. Operating time was 427.29 hrs.

1.6.17 Helicopter technical records show neither defects nor failures in the engines and other components of P-313 before the accident, which could affect the flight.

1.7 Meteorological information

1.7.1 From 8 July, 2005, it was relatively warm and humid throughout the country affected by weakening low pressure and was over cast by clouds of 5 to 6bars with ceiling of 600m to 1,000m. And the visibility was hindered by the mist.

1.7.2 Aerodrome meteorological information at 21:00 on 9 July was as follows;
“wind 150° 3m/s, visibility 7,000m, cloud 8 bars, ceiling 600~1,000m, temperature + 23°C, QFE 749mm, no precipitation and significant weather remarks”

1.7.3 Aerodrome meteorological information informed by controller during return flight was as follows;

“wind 150° 3m/s, visibility 7,000m, cloud 7 bars, ceiling 800m, temperature + 21°, QFE 749mm”

1.7.4 Weather forecast from 15:00 to 24:00 was reported that “wind 120° 3m/s, visibility 6,000m, cloud 7 bars, ceiling 900m and occasional showers”.

1.7.5 At 21:00 on 9 July, the weather condition, which had been reported from Jameado, was generally cloudy with light landward wind.

1.8 Aids to navigation

The helicopter was equipped with a gyrocompass (ГМК-1А), and automatic radio compass (АПК-9), and the crew kept a portable GPS (GPS195)

There was neither flight recorder nor cockpit voice recorder on helicopter.

1.9 Communication

Constant communication was maintained between ATC and helicopter before it was cut off after occurrence.

1.10 Information on place of accident

It is a valley surrounded by low ridges and 60,000 voltage power lines intersect north and west.

There are warehouse buildings along the valley and roads in the South-west.

There was a heap of wood for warehouse repair works (approximately 8m in length, 6m in width, and 9m in height) in the place between warehouse and guardhouse.

Fence (1.7m in height) is along the edges of south-west road, over which lies dent of 2 to 3 m lower than road level.

Its AMSL is 30m.

1.11 ATC-helicopter communication data

The ATC-helicopter communication data recorded in ATC recorder were reviewed by investigators.

1.12 Wreckage distribution

The crashed helicopter's fuselage lay towards the north, inclining to the left at an angle of 37°.

Front and central part of fuselage were too compressed and burnt out to be recognized.

Engines were kept being rolled 60 to 80 degrees left.

Gearbox body was burnt out and its gears and bearings were exposed.

Main rotor hub lay about 70 degrees backward in left roll attitude.

Pieces of main rotor blades scattered within the area of 30 to 40m, when the blade No5 was broken and struck through guardhouse and other blades were cut and damaged.

Tailboom was sustained by fence and tail end was separated from tailboom, being suspended in the air by wire rope of direction control system.

Tail rotor blades which were broken in the middle were attached to the hub.

There were flight manual, operations and other manuals, maintenance tools, personal effects and other medical equipment and instruments.

1.13 Medical information

No negative medical factors were confirmed which were likely to affect activities of the crew.

1.14 Survival information

Persons on board had no possibility of survival due to heavy impact at the time of crash and following explosive fire.

1.15 Rescue and fire fighting

1.15.1 Fire engines and rescue units began to arrive at the site about 35 minutes after accident.

8 fire engines were mobilized for fire fighting; 2 from aerodrome, 4 from Pyongyang city, 1 from Hyongjesan district and 1 water supply engine.

1.15.2 Fire on helicopter was totally pressed down at about 01:20 next day.

2. ANALYSIS

2.1 General

Air Koryo specified conditions and procedures for flight on call in accordance with the purpose of helicopter operation.

Crew and maintenance personnel on duty were on standby in their place near apron.

2.2 Flight operation organization

Being maintained by 3rd Technical Service in the morning that day, the helicopter was on standby for any flight.

When they accepted the instruction from the fleet chief at 20:40, the crew arrived at the helicopter to make pre-flight preparation with maintenance personnel for 30 minutes.

2.2.1 Crew preparation

Crew made duty preparation for 2 hours in accordance with established procedures.

For the duty preparation, they studied and discussed flight procedures in normal and abnormal situations.

And the pilot-in-command confirmed weather forecasts for duty period.

Crew preparation for duty was checked by the chief of 3rd fleet.

No finding was discovered in medical check, which was likely to affect flight.

2.2.2 Flight operation

After flight preparation, the crew took off at 21:20 with an obstetrician and a nurse on board and arrived at Jamaedo at 21:57. It took 37 minutes including 5 minutes necessary for approach layout.

They took off at 22:46 and flew at 900m along the route of Jamaedo-Pyongyang.

On request of ATC, the crew reported that weather condition was relatively good, but some clouds were encountered at the altitude of 900m.

As they passed over Ryupori at 23:02, the crew requested ATC to approve descent from 900m to 300m for approach.

The controller approved the descent from 900m to 300m as they requested

At around 23:10, the pilot-in-command reported decrease of engine oil pressure, when the helicopter might have arrived at an altitude of 300m.

Thereafter, the pilot-in-command said engine shut off.

Being informed that engine oil pressure was falling down, ATC controller continued calling crew to confirm detailed situation, but had no response.

According to all informations collected and ATC-helicopter communication recordings, it is assumed that the crew stopped left engine at a speed of 200km/h at the altitude of 300m by whatever reason that they would have discovered engine oil system failure or had a misinterpretation of meter reading.

Mi-8 flight manual requires that *“in the case of oil depression, readings of engine oil temperature meter and engine testing meters should be crosschecked and the engine must be stopped immediately, if the pressure decreases below 2 kg per sq.sm or oil temperature increases above 125 degrees.”*

The crew seem to have felt uneasiness that an engine could be melted down due to engine oil cutoff.

The investigators inspected the helicopter systems and meters including engine oil system, control system and electrical system from the wreckage but since the helicopter was totally destroyed and burnt out, could not find any evidence related with oil system failure.

No strike was found on the left engine compressors.

Investigation of the left engine in disassembly shows no evidence of meltdown due to the the improper oil supply to bearings of engine spindle supporting unit.

However, 20 inlet fan blades of the right engine had apparent signs of strikes, 4 of which were damaged seriously.

These evidences show that the left engine was not operating during the crash, whereas the right engine was operating until the moment of the collision against the ground.

There seems to have been confused situation in the cockpit, where the crew violated coordination and control procedures established in flight manual for engine shut down and had inconsistent argument.

Flight manual requires that i) "in the case of one engine failure(shutdown), flight speed , If more than 120km/h, should be reduced to 120 to 130km/h without loss of height by pulling the control stick or climbing."... ii) "Left pedal should be used to stop tendency of turning right and main rotor speed should be kept not below 89%."... iii) "control lever of the operating engine should be at the uppermost position (take-off rating)."

However, the main rotor speed would have been dropped below 89%, as the crew stopped an engine at nearly 200km/h and did not retard pitch-throttle control lever immediately.

After recognition of main rotor speed below 89%, the crew, for rapid recovery, would have hastily retarded pitch-throttle control lever nearly to the minimum, which caused the helicopter descending at a vertical rate of more than 10m/s.

It seems that the crew discovered obstacles at a level of 30 to 50m from the ground, when they pulled the stick to reduce the vertical rate of descent and recover helicopter attitude.

The crew, instinctively, would have pulled the stick and pitch-throttle control lever to the maximum sharply in order to avoid collision against obstacles. Then, it is considered that the helicopter descent might have been reduced momentarily but the diving could not be stopped with only one engine power.

During the investigation, it was confirmed that sliding axle plate of automatic slope controller was in maximum limit and its booster piston rod being in maximum position (47mm).

It shows that the crew pulled pitch-throttle control lever to the maximum.

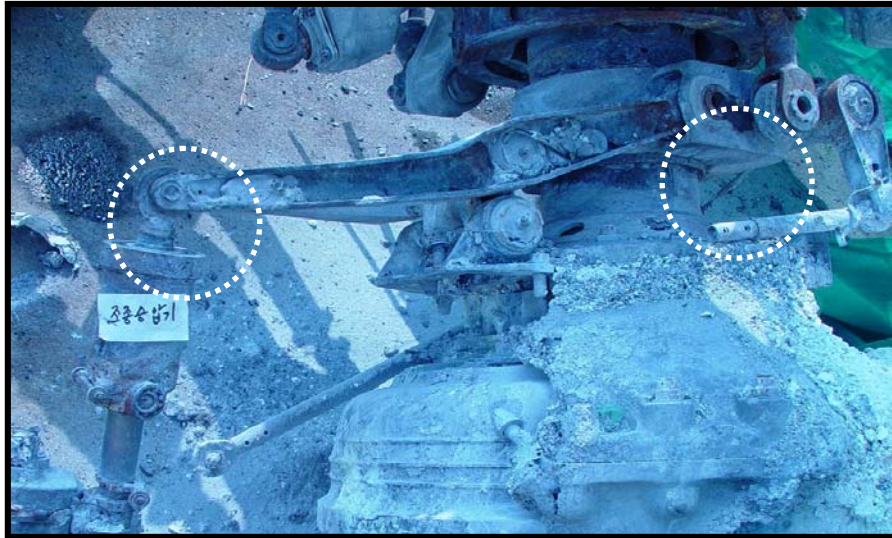


Figure 1 Positions of automatic slope controller sliding plate and booster

As a result, the helicopter had a nearly vertical descent and the main rotor disc collided with the top side of the heap of wood. The main rotor blade No5 was broken and thrown into the guardhouse roof due to heavy impact and rotating moment and other blades (No 4,3,2,1) sequentially collided in rotation direction, being broken out or bent.

During the investigation, it was also confirmed that the right engine control lever had not been at the uppermost.

Even though the helicopter was capable of flight with only one engine in its mass and performance, the crash occurred due to the crew having failed to comply with timeliness and sequence in control.

The crew failed to maintain main rotor speed above 89%, and to pull the right engine control lever to the uppermost.

During the investigation, it was confirmed that the cut-off valve of the left engine was in open, which seems that the crew have tried engine restarting.



Figure 2 Positions of rotation lever of engine high pressure fuel pump and cut-off valve

At night flight, the pilots' careful situation awareness, right decision making and smooth control are crucial to ensure flight safety.

The crew maintained an average ground speed of 180km/h during the flight to Jamaedo, but 200km/h from Jamaedo to Ryupori and 220 to 230km/h from Ryupori to Kanri.

Such flight speed might be allowable, however, it is analysed that the crew maintained the speed of 30 to 40 km/h higher than normal.

The pilot who had experienced to continue the flight by restarting one engine stopped by icing, told that one engine failure could result in a loss of altitude of more than 300 to 400m and said;

"When one engine stopped at an altitude of 2,000m due to icing, I stabilized the helicopter attitude turning right and descending and managed to restart the engine in the air.

The stabilized altitude was 1,100m, at which the loss of altitude was 900m."

If he had flown with enough margin of altitude, the pilot-in-command could have continued his flight to the aerodrome with one engine.

2.2.3 Meteorological conditions

Normal operation of the helicopter was not affected by weather information and forecasts on aerodrome, route and landing pad, which were taken by the crew before their departure.

The inhabitants said that there had been a thin layer of fog around the valley where the helicopter crashed.

As sunset time was 20:06, moonrise time 7:31 and moonset time 22:37 that day, it was relatively dark at the time of accident.

2.2.4 ATC control

The controller cleared flight of helicopter on duty after confirming weather and flight conditions.

He sought to maintain the communication with helicopter, but failed to contact with it again upon the receipt of last urgent report from the crew.

2.2.5 Communication

ATC-helicopter communication was normal before accident.

2.2.6 Navigation equipment

Neither failure nor malfunction of navigation equipment affected the determination of the flight direction.

2.2.7 Place of accident

With its undulating character in topography, it is an uneven area where dwelling houses and buildings densely situated.

2.3 Helicopter

2.3.1. Helicopter maintenance

Helicopter maintenance was done in accordance with maintenance processes and procedures specified in maintenance and handling manuals.

200 hour maintenance was performed in Maintenance Workshop on 17 January, 2005.

Last 50 hour maintenance was done in this workshop on 11 May, 2005 and no fault was found.

The crew supplemented 10 litres of oil to each engine and 32 litres to main gearbox. The oil supplied was B-3B.

2.3.2 Helicopter performance

Helicopter maintenance and pre-flight preparation ensured its airworthiness and flight performance.

2.3.3 Weight and balance

Payload of helicopter was about 300kg including persons and equipment, and its balance was calculated +200mm. The helicopter mass was 8,500kg.

2.3.4 Helicopter instruments and equipment

They did not affect flight operation.

2.3.5 Helicopter systems

All systems were set up independently so as to enable it to fly by means of other systems or alternate instruments, even in case of one failure.

2.4 Human factors

Father of the pilot-in-command was fell unconscious due to the cerebral thrombosis on 7 July, but began to recover after being treated by doctors.

Factors of the health, which could have affected the normal life and flight operation of other crewmembers, were not found.

2.5 Survival aspects

2.5.1 Activities of rescue unit

Fire engines and rescue units begun to arrive at the site about 35 minutes after the occurrence of the accident.

The guards of warehouse failed to rescue persons on board, for the helicopter exploded and burst into flames.

2.5.2 Physical injuries and disaster

Persons on board suffered fatal injuries due to severe crash impact and subsequent fire, and the following fire rapidly expanded to warehouse building, nearly burning it out.

3. CONCLUSION

3.1 Information confirmed by investigators

3.1.1 Crew information

The crew had valid licences for their flight operation.

They all had valid first class medical examination assessments.

They undertook their duties after having full pre-flight rests in compliance with limitations on flight time, duty period and rest time.

Aeronautical and weather information did not affect flight operation.

3.1.2 Helicopter information

The helicopter had a valid certificate of airworthiness.

It had a valid maintenance release.

Scheduled maintenance, pre-flight and post-flight maintenance were completed in accordance with the established procedures.

Helicopter airworthiness inspections were done on a regular basis.

Helicopter weight and balance were within established limits.

Fuel supplied that day was 2,300 litres (1,850kg), of which 1450 litres (1,150kg) were estimated to be in fuel tanks at crash.

It was China 3 fuel with specific gravity of 0.798.

3.1.3 Flight operations

The crew performed flight after pre-flight preparation in accordance with established procedures.

They took off at 21:20 and conducted normal flight along the established route until landing at Jamaedo at 21:57.

They departed Jamaedo at 22:46 for Pyongyang aerodrome.

Duty schedule, helicopter transfer record and operations records were prepared accurately.

The pilot-in-command shut down the normal engine without confirming faulty readings of engine oil system meter, which was a serious mistake.

And the pilot-in-command and other crew members failed to perform rapid and accurate coordination and control in the circumstance where one engine was shut off.

3.2. Cause of accident

3.2.1 The crew stopped an engine without confirmation of crosschecking engine oil system pressure meter with oil temperature meter.

3.2.2 The crew did not perform coordination and helicopter control accurately in accordance with the procedures in flight manual when one engine was inoperative.

- 3.2.3 Airline did not organize duty, taking due account of personnel concerns in life and family.

4. SAFETY RECOMMENDATIONS

- 4.1 Airline should conduct training for landing with one engine shutdown for all helicopter pilots and permit the flight of only those members who have successfully passed.
- 4.2 Airline should inspect powerplants, control system, fuel and oil systems, and instruments for further flight.
- 4.3 Airline should conduct supersonic cleansing of fuel filters and inspect oil filters without regard to scheduled maintenance for further flight.
- 4.4 Airline should give crew repetitive training on probable failures in engine, control, oil, hydraulic systems, and following emergency procedures.

Kim Ryong Ho, Chief Investigator,
Aircraft Accident Investigation Committee

3 October, 2005